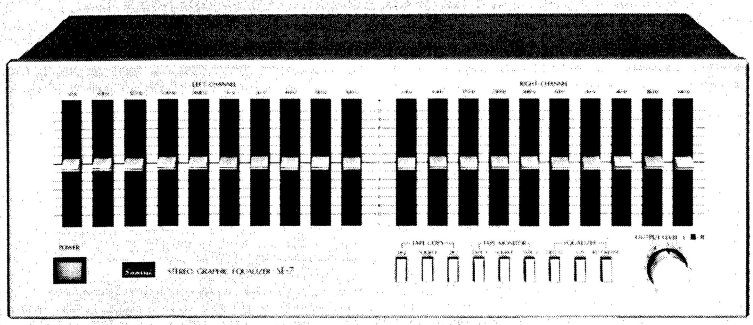
SERVICE MANUAL

STEREO GRAPHIC EQUALIZER

SANSUI SE-5/7



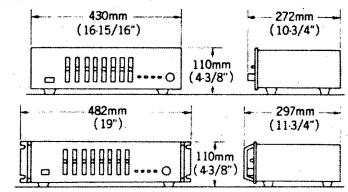
Sansui

SANSUI ELECTRIC CO., LTD.

SPECIFICATIONS

<SE-5>

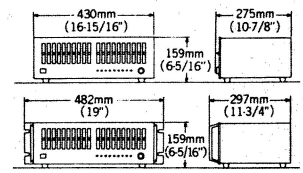
Input impedance (1,000 Hz)
INPUT . . . . . 30 kilohms
Output level and impedance (1,000 Hz)
OUTPUT . . . . . 1 V into 47 kilohms at 1V input/ 600 ohms
(Maximum output level: 5 V at 0.5 % total harmonic distortion)
Total harmonic distortion (20 Hz to 20 kHz)
INPUT . . . . . less than 0.008 %
Frequency response (at rated output, Equalizer controls: "0" position) . . . . 10 to 100,000 Hz, +0 dB, –1 dB
Equalizer frequency . . 80 Hz, 160 Hz, 315 Hz, 630 Hz, 1.25 kHz, 2.5 kHz, 5 kHz, 10 kHz
Level variation range . . ±12 dB
Hum and noise (short-circuit, A-network)
. . . . . 110 dB
Gain (1,000 Hz, Equalizer controls: "0" position)
. . . . . 0 dB
Power requirements
Power voltage . . . . 100, 120, 220, 240 V (50/60 Hz)
For USA and Canada
. . . . . 120 V (60 Hz)
Power consumption
Rated consumption
. . . . . 7 watts
Dimensions . . . . . .



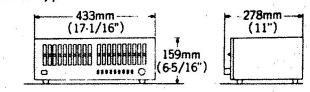
Weight . . . . . 3.7 kg (8.2 lbs.) net
4.9 kg (10.8 lbs.) packed

<SE-7>

Input impedance (1,000 Hz)
INPUT . . . . . 30 kilohms
Output level and impedance (1,000 Hz)
OUTPUT . . . . . 1 V into 47 kilohms at 1 V input/ 600 ohms
(Maximum output level: 5 V at 0.5 % total harmonic distortion)
Total harmonic distortion (20 Hz to 20 kHz)
INPUT . . . . . less than 0.008 %
Frequency response (at rated output, Equalizer controls: "0" position) . . . . 10 to 100,000 Hz, +0 dB, –1 dB
Equalizer frequency . . 32 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz
Level variation range . . ±12 dB
Hum and noise (short-circuit, A-network)
. . . . . 110 dB
Gain (1,000 Hz, Equalizer controls: "0" position)
. . . . . 0 dB
Power requirements
Power voltage . . . . 100, 120, 220, 240 V (50/60 Hz)
For USA and Canada
. . . . . 120 V (60 Hz)
Power consumption
Rated consumption
. . . . . 7 watts
Dimensions . . . . . .
Black type



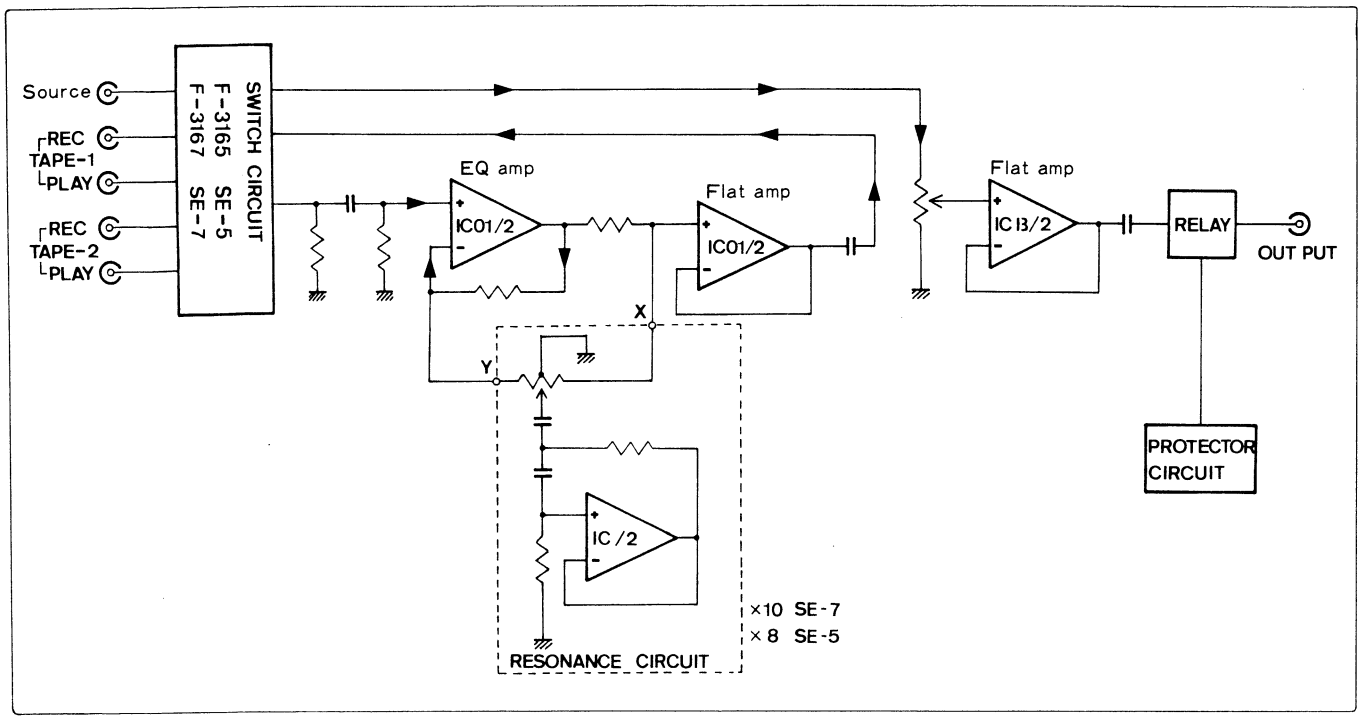
Silver type



Weight
Black type . . . . . 4.5 kg (9.9 lbs.) net
6.0 kg (13.2 lbs.) packed
Silver type . . . . . 4.0 kg (8.8 lbs.) net
5.2 kg (11.5 lbs.) packed

* Design and specifications subject to changes without notice for improvements.
* In order to simplify the explanation illustrations may sometimes differ from the originals.

1. BLOCK DIAGRAM



2. OPERATION

2-1. Outline (See block diagram.)

The graphic equalizers, Models SE-5 and SE-7, consist of a plurality of resonance circuits (8 units for SE-5, 10 units for SE-7) using a semiconductor inductor, an EQ amplifier using the resonance circuit, and flat amplifiers.

2-2. Basic Operation of Resonance Circuit and OP Amp. (Operational Amplifier)

The resonance circuit (Fig. 2-1) is built with an OP amp, resistors, and capacitors, having an equivalent circuit as shown in Fig. 2-2. It is customary that an OP amp in any circuit is handled as an ideal one for convenience. In this case, the OP amp meets the following requirements:

1. Voltage gain : Infinity
2. Band width : Infinity
3. Input impedance Zin : Infinity
4. Offset, Drift : Zero
5. Output impedance Zout : Zero
6. Common mode rejection ratio : Infinity

Thus, when a signal voltage is applied to the inversion input terminal of the OP amp as shown in Fig. 2-3, current flows through the resistors R_D and Rf, but none flows into the inversion input terminal because the input impedance of ideal OP amp is infinity. The voltage at inversion input is 0V because the non-inversion terminal is grounded and input difference voltage (Vd) between the two input terminals of OP amp is always 0V (since the inversion input is always at the same potential as the non-inversion input, the inversion input is said to be at virtual ground.)

Applying Ohm's law to the above, the voltages V_0 and V_1 are:

$V_0 = -I_2 \times Rf$

$V_1 = I_1 \times R_D$

Fig. 2-1 Resonance Circuit

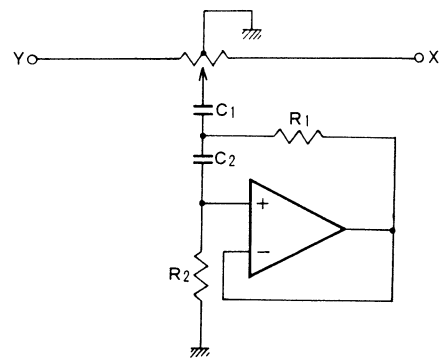
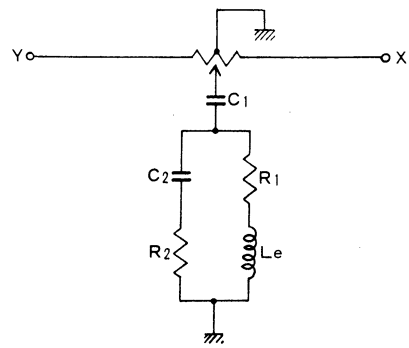


Fig. 2-2 Precise Equivalent Circuit



Furthermore, since no current flows through the OP amp. $I_1 = I_2 = I$ and thus the voltage gain Av is:

$$Av = \frac{V_0}{V_1} = \frac{-I \times Rf}{I \times R_D} = -\frac{Rf}{R_D}$$

Similarly, when a signal voltage is applied to the non-inversion terminal as shown in Fig. 2-4, the voltage at the inversion input terminal and non-inversion input terminal are the same . Thus,

$$V_0 = I_2 \times (R_D + Rf)$$

$$V_1 = I_1 \times R_D$$

$$Av = \frac{V_0}{V_1} = \frac{I \times (R_D + Rf)}{I \times R_D} = (1 + \frac{Rf}{R_D})$$

In the OP amp of the resonance circuit (Fig. 2-5) used in SE-5 and SE-7, Rf = 0 and $R_D = \infty$. The reason for the former is that a signal voltage is applied to the non-inversion input terminal and a feedback is directly given from the output terminal to the inversion input terminal. That for the latter is that no resistance for voltage division is connected to the inversion input terminal. Using the formula determined for an OP amp with a non-inverted input, the voltage gain is:

$$Av = 1 + \frac{Rf}{R_D} = 1 + \frac{0}{\infty} = 1$$

2-3. Resonance Circuit

This means the input voltage V_{in} appears at the output terminal as an output voltage V_0 equal to it.

In Fig. 2-5, the voltage V_S applied to the Point Ⓐ produces the currents I_2 flowing through the capacitor C_2 and resistor R_2, and I_1 flowing through the resistor R_1, voltages V_{C2}, V_{R2} (V_{in}), and V_{R1} developing across C_2, R_2, and R_1 respectively. (Here, recall that the OP amp is an ideal one, and its input impedance is of infinity and therefore no current flows through it.) Since the voltage gain of this OP amp is 1, the voltage V_{in} is equal to the voltage V_0.

Here, consider the current I_2 flowing through C_2 and R_2 coupled in series. If the frequency of V_S applied to point Ⓐ is increased without varying its magnitude, the impedance of the series circuit (C_2 and R_2) decreases. Therefore, current I_2 flowing the series circuit increases, which causes voltage decrease across C_2 (V_{C2}) and voltage increase across R_2 (V_{in}). The voltage of V_{C2} added to V_{in} equals V_S, V_{in} is the same potential of V_0, and V_{R1} added to V_0 equals V_S that V_{R1} always equals V_{C2}.

Similarly, consider the current I_1. If frequency of V_S is increased, V_{C2} decreases and so does V_{R1} because V_{C2} equals V_{R1}.

This means that I_1 is decreased because R_1 has no frequency characteristic, and V_0 (voltage between point Ⓑ and ground) is increased, since the magnitude of V_S is fixed and V_S equals V_{R1} plus V_0.

Therefore viewing the OP amp from point Ⓑ, the characteristic of the OP amp is equavalent to an element of which characteristic is that the higher the applied frequency becomes, the smaller the flowing current and the higher the voltage across the element become, namely equavalent to a coil connected between point Ⓑ and ground.

From the above, the circuit shown in Fig. 2-5 is equal to the equavalent circuit of Fig. 2-2 and if the current flowing the series circuit (C_2 and R_2) is negligible, Fig. 2-2 becomes series resonance circuit as Fig. 2-6.

These relations are shown by the following equations (Fig. 2-5):

$$V_S = I_1 R_1 + V_0 \quad \cdots\cdots 1$$

$$V_S = I_2 X_{C2} + I_2 R_2 \quad \cdots\cdots 2$$

$$V_0 = Vin = I_2 R_2 \quad \cdots\cdots 3$$

Substitution of Eq. 3 into Eq. 1 gives:

$$V_S = I_1 R_1 + I_2 R_2 \quad \cdots\cdots 4$$

Eliminating $I_2 R_2$ by Eqs. 2 and 4 gives:

$$I_2 = \frac{R_1}{X_{C2}} I_1 \quad \cdots\cdots 5$$

Substitution of Eq. 5 into 4 gives:

$$I_1 = \frac{V_S}{R_1 + \frac{R_1 R_2}{X_{C2}}} \quad \cdots\cdots 6$$

When I_2 is negligibly smaller than I_1, the impedance viewing from the point A is:

$$Z = \frac{V_S}{I_1} = R_1 + \frac{R_1 R_2}{X_{C2}} \quad \cdots\cdots 7$$

Since $X_{C2} = \frac{1}{j\omega C_2}$, Eq. 7 becomes:

$$Z = R_1 + j\omega C_2 R_1 R_2 \quad \cdots\cdots 8$$

This Z is equivalent to the impedance of the circuit through which I_1 flows. (Fig. 2-5) In Eq. 8, let $j\omega Le$ stand for $j\omega C_2 R_1 R_2$. Then, Eq. 8 is:

$$Z = R_1 + j\omega Le$$

This means that the circuit consists of a resistor R_1 and a coil (with a reactance of Le) connected in series with each other.

The resonance frequency (f_0) can be obtained by the following equation

$$f_0 = \frac{1}{2\pi\sqrt{C_1 C_2 R_1 R_2}}$$

Fig. 2-3 Inversion OP Amp.

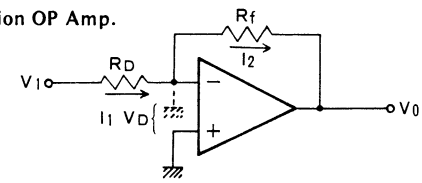


Fig. 2-4 Non-inversion OP Amp.

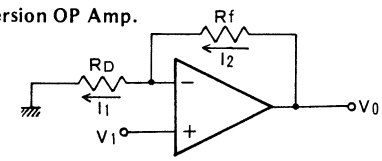


Fig. 2-5 Resonance Circuit

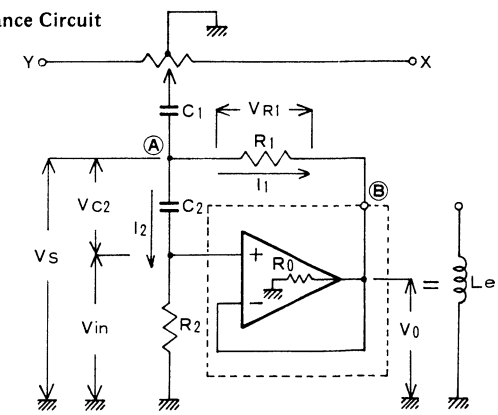
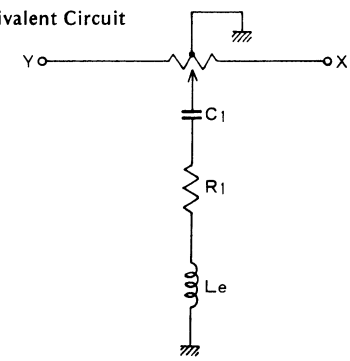


Fig. 2-6 Equivalent Circuit



2-4. EQ amplifier

As shown in Fig. 2-7, the EQ amplifier comprises a resonance circuit using a Semiconductor Inductor and an OP amp.

Suppose that the input signal voltage Vin applied to the EQ amplifier has the resonance frequency f_0.

When the resonance circuit is grounded, that is, when the variable resistor is set to the mid-point (b) as shown in Fig. 2-7, the voltage gain Av_1 of the EQ amplifier can be determined from the formula used for non-inversion amplifier as follows:

$$Av_1 = 1 + \frac{Rf}{r_1}$$

Thus, the output voltage V_0 is $(1 + \frac{Rf}{r_1})$ times the input voltage Vin.

When the variable resistor is set to the leftmost position (point a), the impedance Z of the resonance circuit includes only an R component due to the input signal with the resonance frequency fo, and therefore, r_1 and R form a parallel circuit. When R is negligibly smaller than r_1, it can be supposed that only R is connected to the non-inversion input terminal of the EQ amplifier. Thus, the voltage gain is:

$$Av_2 = 1 + \frac{Rf}{R}$$

Since $r_1 > R$, $Av_1 < Av_2$.

When the resonance circuit is connected leftwards from the point b of the variable resistor, the output voltage V_0 is divided by R_1 and r_2 and appears as Vx at the point Ⓧ.

$$Vx = \frac{r_2}{R_1 + r_2} V_0$$

When the resonance circuit is connected to the rightmost point c, V_0 is divided by R_1 and $\frac{r_2 Z}{r_2 + Z}$ (impedance of the parallel circuit comprising r_2 and Z).

From the above, the following relation can be found:

Vxa (Vx for resonance circuit connected to the point a) > Vxb > Vxc

This shows the "peak characteristic" of the EQ amplifier as Fig. 2-8.

Fig. 2-7 EQ Amp.

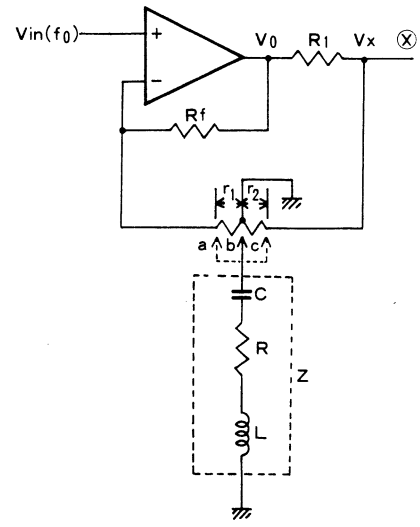
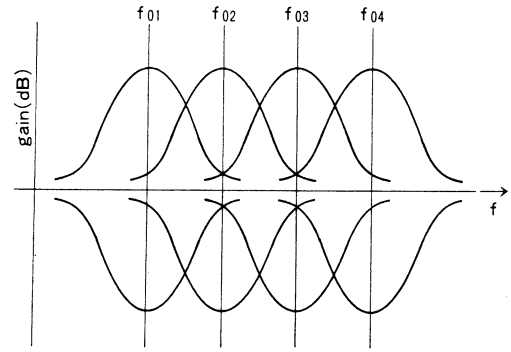


Fig. 2-8 Peaking Characteristics

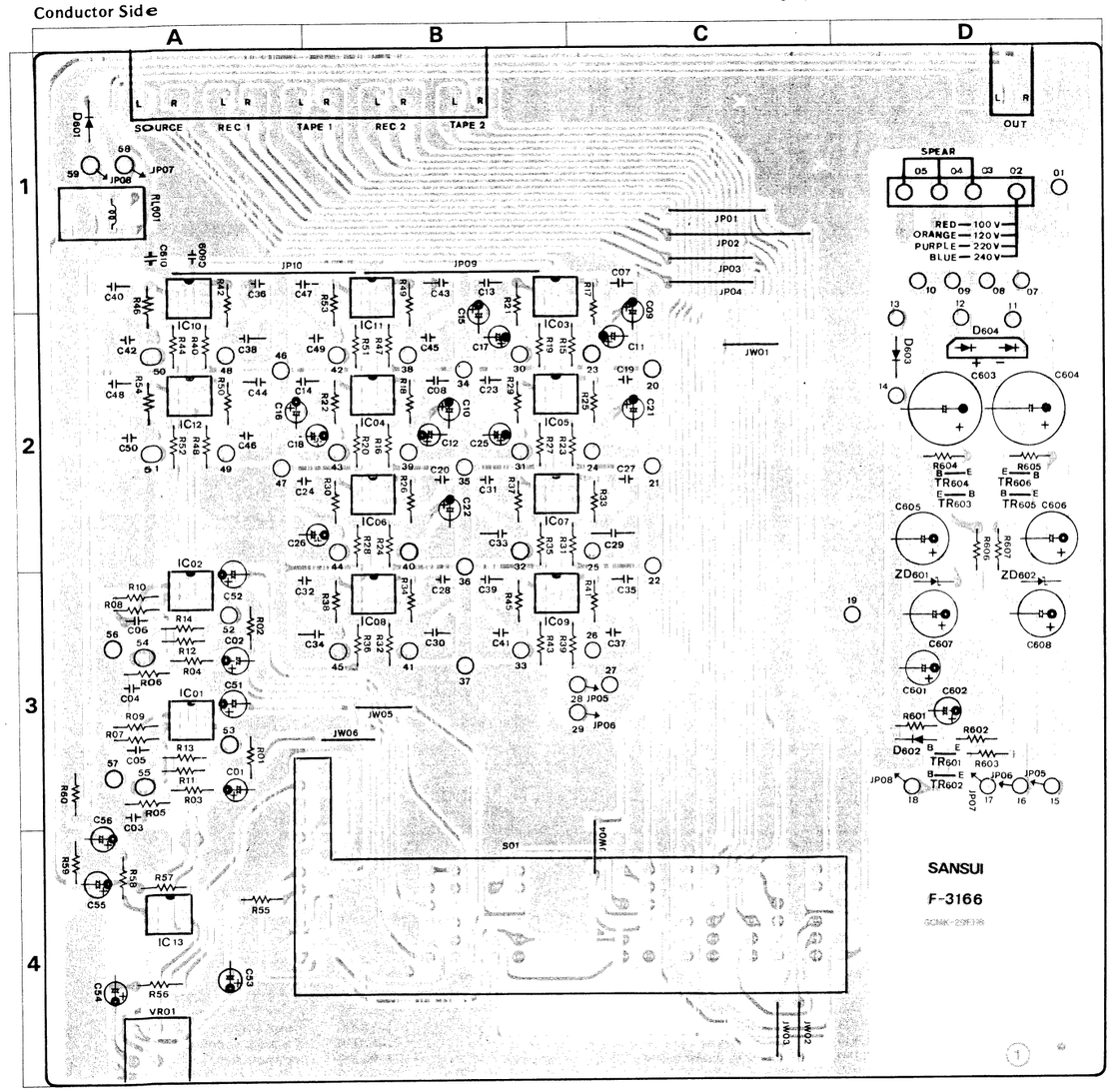


3. PARTS LOCATION & PARTS LIST

- Since some of capacitors and resistors are omitted from parts lists in this Service Manual, refer to the new Common Parts List for capacitors & resistors.
- As the stock number in the parts list on this service manual is indicated in 8 digit to differ from ordinary 7 digit, please be careful when ordering parts.

3-1. F-3166 Main Circuit Board (Stock No. 75632801 = SE-7)

Conductor Side



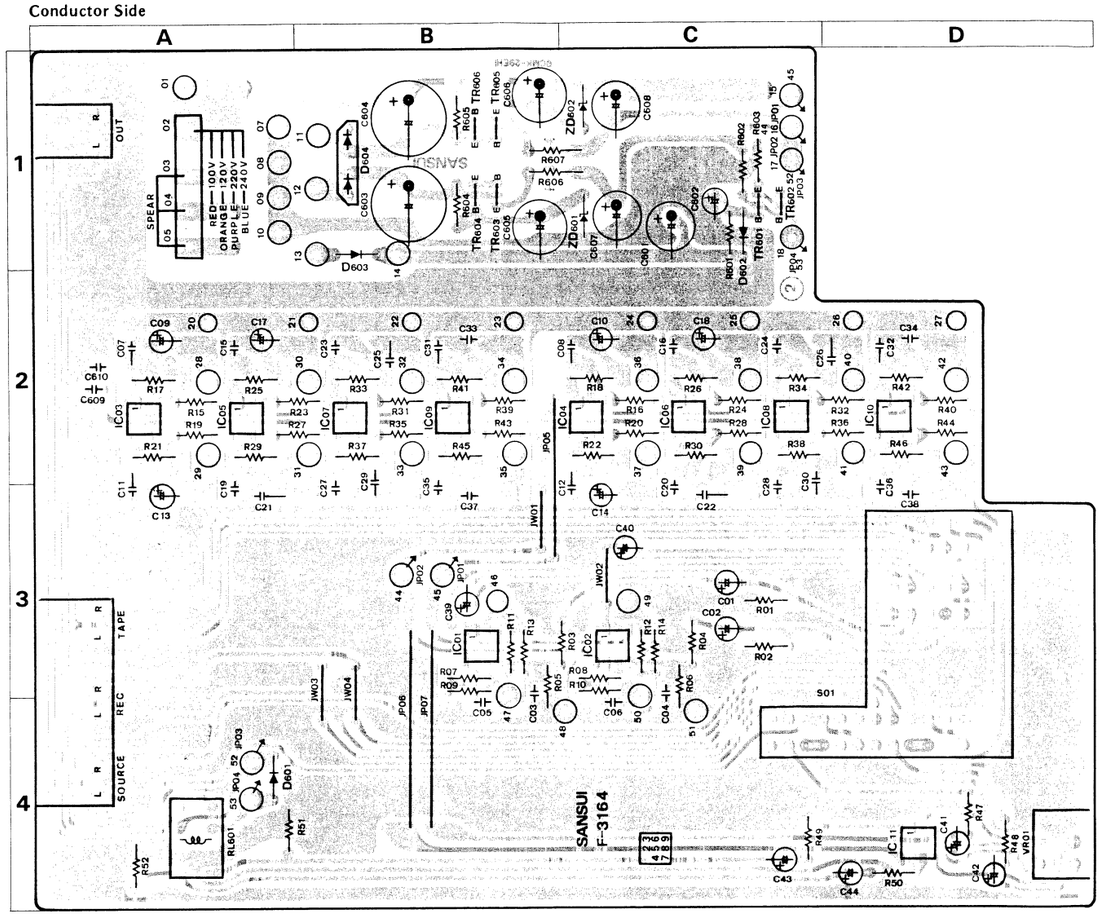
Parts List

Parts No.	Stock No.	Description
•Transistor		
TR601	03062900, 1	2SC1400-1 E, U
TR602	03008900, 1	2SA750-3 E, U
TR603	03086101, 2	2SD357 D, E
TR604	03062900, 1	2SC1400 E, U
TR605	03034401, 2	2SB527 D, E
TR606	03008900	2SA750 E, U
•IC		
IC01, 02	03613800	NJM4559D D
IC03 ~ 13	03607700	NJM4558D
•Diode		
D601	03103400	10D1
D602	03111800	1S1588
D603	03103400	10D1
D604	03117000	RB-152
•Zener Diode		
ZD601	03160000	EQA01-16R
ZD602	03160000	EQA01-16R
VR01	10250500	Volume 50kΩ (A) x 2
S01	11323400	Push Switch, TAPE COPY
RL601	11505100	Relay

Parts No.	Stock No.	Description
	22007200	Input Terminal, source, tape 1, rec 1
	22007100	Input Terminal, tape 2, rec 2
	22007000	Output Terminal

3-2. F-3164 Main Circuit Board (Stock No. 75632901 = SE-5)

Conductor Side



Parts List

Parts No.	Stock No.	Description
•Transistor		
TR601	03062900, 1	2SC1400-1 E, U
TR602	03008900, 1	2SA750-3 E, U
TR603	03086101, 2	2SD357 D, E
TR604	03062900, 1	2SC1400-1 E, U
TR605	03034401, 2	2SB527 D, E
TR606	03008900, 1	2SA750-3 E, U

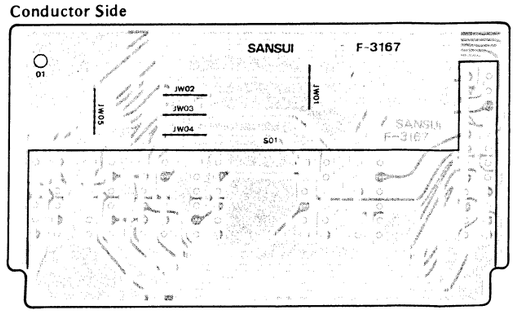
Parts No.	Stock No.	Description
•IC		
IC01, 02	03613800	NJM4559D D
IC03, 12	03607700	NJM4558D
•Diode		
D601	03103400	10D1
D602	03111800	1S1588

Parts No.	Stock No.	Description
D603	03103400	10D1
D604	03117000	RB-152
•Zener Diode		
ZD601	03160000	EQA01-16R
ZD602	03160000	EQA01-16R
VR01	10156500	Volume 50kΩ, Output Level
S01	11323300	Push Switch, Equalizer, Tape Monitor
RL601	11505100	Relay

•The circuit boards, F-3167, F-3165 & F-3168 are not supplied as the assembled.

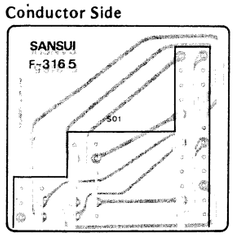
3-3. F-3167 Switch Circuit Board (SE-7)

Conductor Side



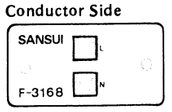
3-4. F-3165 (SE-5)

Conductor Side



3-5. F-3168 (SE-5)

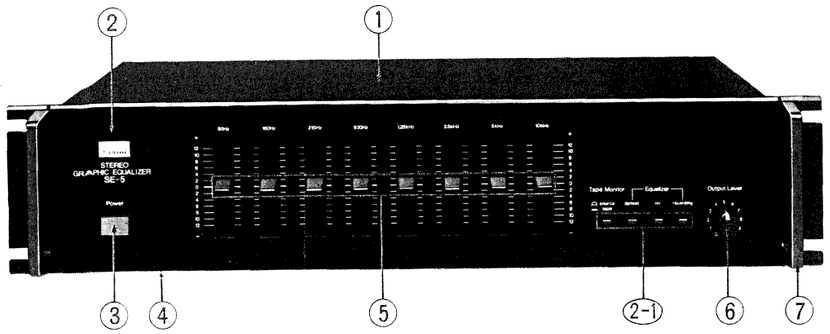
Conductor Side



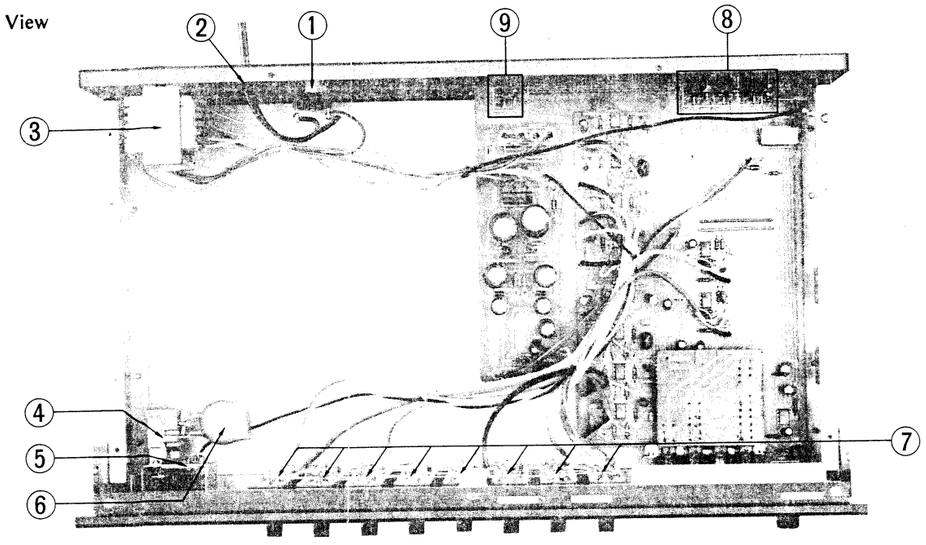
4. OTHER PARTS

4-1. SE-5

A) Front View



B) Top View



Parts List <Front View>

No.	Parts No.	Stock No.	Description
1		50069830	Bonnet
2		70085910	Front Panel Ass'y
		50048700	Masking Sheet
		50485000	Masking Plate
2-1		71061500	Knob Ass'y, equalizer, tape monitor
3	S701	11318900	Power Switch
		77262300	Indicator Ass'y (with lamp)
		71063910	Knob, power switch
4		55170700	Leg
5		53269000	Knob, slide volume
6		53189400	Knob, output level
7		53967000	Rack Mounting Adaptor

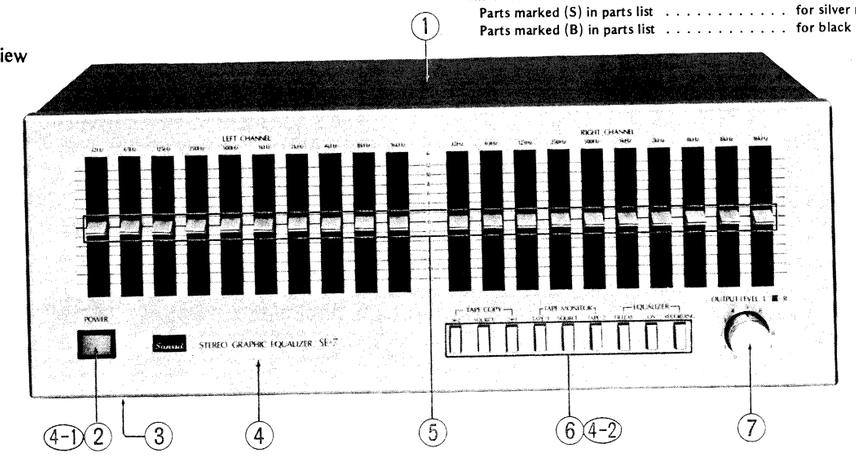
Parts List <Top View>

No.	Parts No.	Stock No.	Description
1		24501100	AC Outlet
2		38004700	AC Cord
		39106000	Strain Relief
3		40033300	Power Transformer
4	S701	11318900	Power Switch
5		77262300	Indicator Ass'y (with lamp)
6		00386000	0.01μF 50V C.C.
7	VR701 ~09	10401700	Slide Volume
8		22007200	Pin Terminal, tape, rec, source
9		22007000	Pin Terminal, output

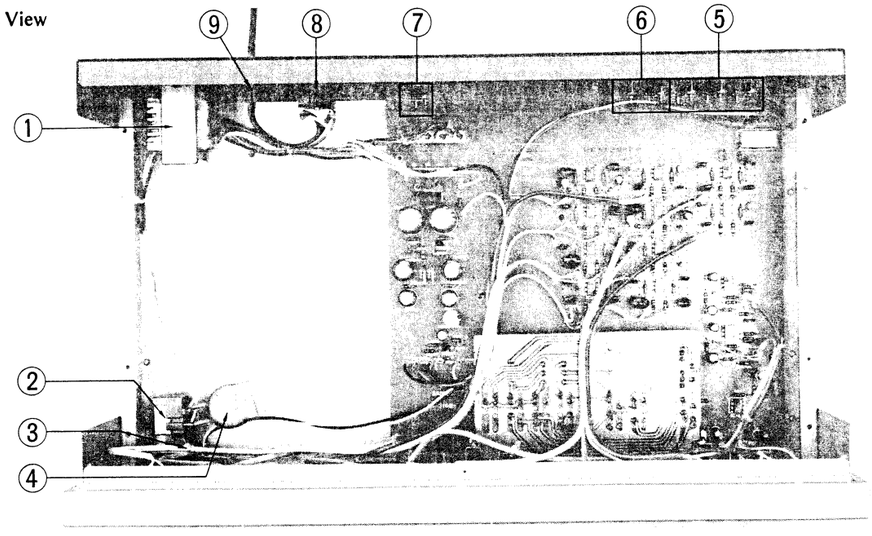
4-2. SE-7

●Since there are black & silver models in SE-7, please pay attention when ordering parts.
Parts marked (S) in parts list . . . . . for silver model only
Parts marked (B) in parts list . . . . . for black model only

A) Front View



B) Top View



Parts List <Front View>

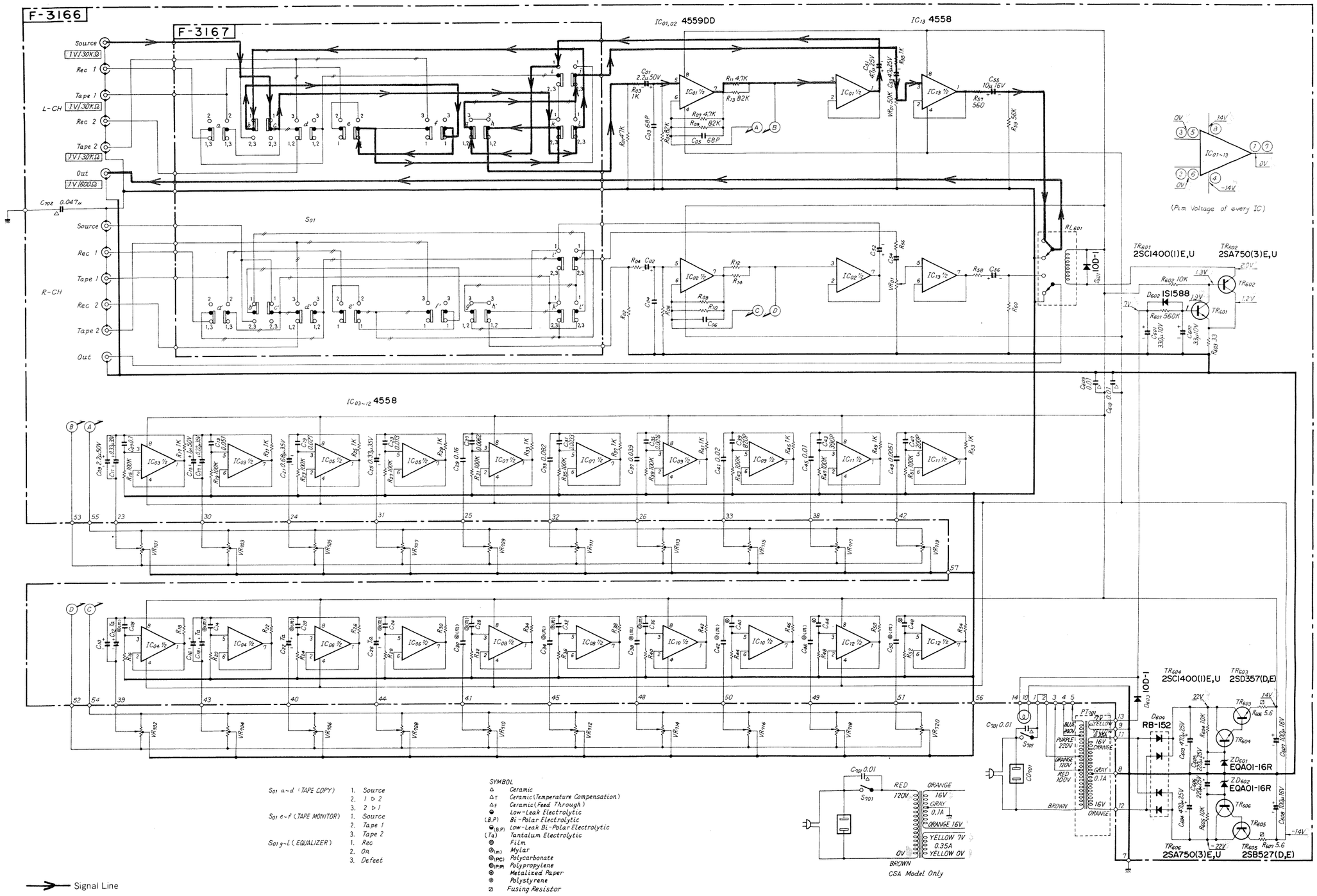
No.	Parts No.	Stock No.	Description
1		57272800	Wood Bonnet (S)
		50070200	Bonnet (B)
		11318900	Power Switch
2		71063910	Knob Ass'y, power switch
		77262300	Indicator Ass'y
3		55170700	Leg
4		70085710	Front Panel Ass'y (S)
		70085810	Front Panel Ass'y (B)
		50485500	Masking Sheet (S)
		07515400	Masking Sheet (B)
4-1		52813910	Knob Guide, power switch
4-2		71061500	Knob Ass'y, EQ, tape copy, tape monitor (B)
5	VR701	10401600	Slide Volume
	~ 720	53269100	Knob, slide volume (S)
		53269000	Knob, slide volume (B)
6		53194910	Push Knob, EQ, tape copy, tape monitor (S)
		52803300	Knob Holder, EQ, tape copy, tape monitor (S)
7		53196100	Knob, (L) output level (S)
		53189510	Knob, (L) output level (B)
		53196000	Knob, (R) output level (S)
		53191900	Knob, (R) output level (B)

Parts List <Top View>

No.	Parts No.	Stock No.	Description
1		40033300	Power Transformer
2		11318900	Power Switch
		71063910	Knob Ass'y, power switch
3		77262300	Indicator Ass'y
4	C701	00386000	0.01μF 50V C.C.
5		22007200	Input Terminal, source, tape 1, rec 1
6		22007100	Input Terminal, tape 2, rec 2
7		22007000	Output Terminal,
8		24501100	AC Outlet
9		38004700	AC Cord
		39106000	Strain Relief

* Design and specifications subject to change without notice for improvement.
* La présention et les spécificatïons sont susceptibles d'éter modifiées sans préavis par suites d'améliorations éventuelles.
* Änderungen, die dem technischen Fortschritt dienen, bleiben vorbehalten.

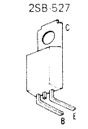
5. SCHEMATIC DIAGRAM 5-1. SE-7



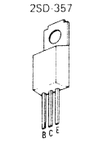
2SA750
2SC1400

NJM4559D
NJM4558D

2SB527

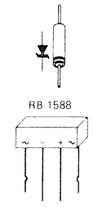


2SD357



1S1588
10D-1

EQA01-16R



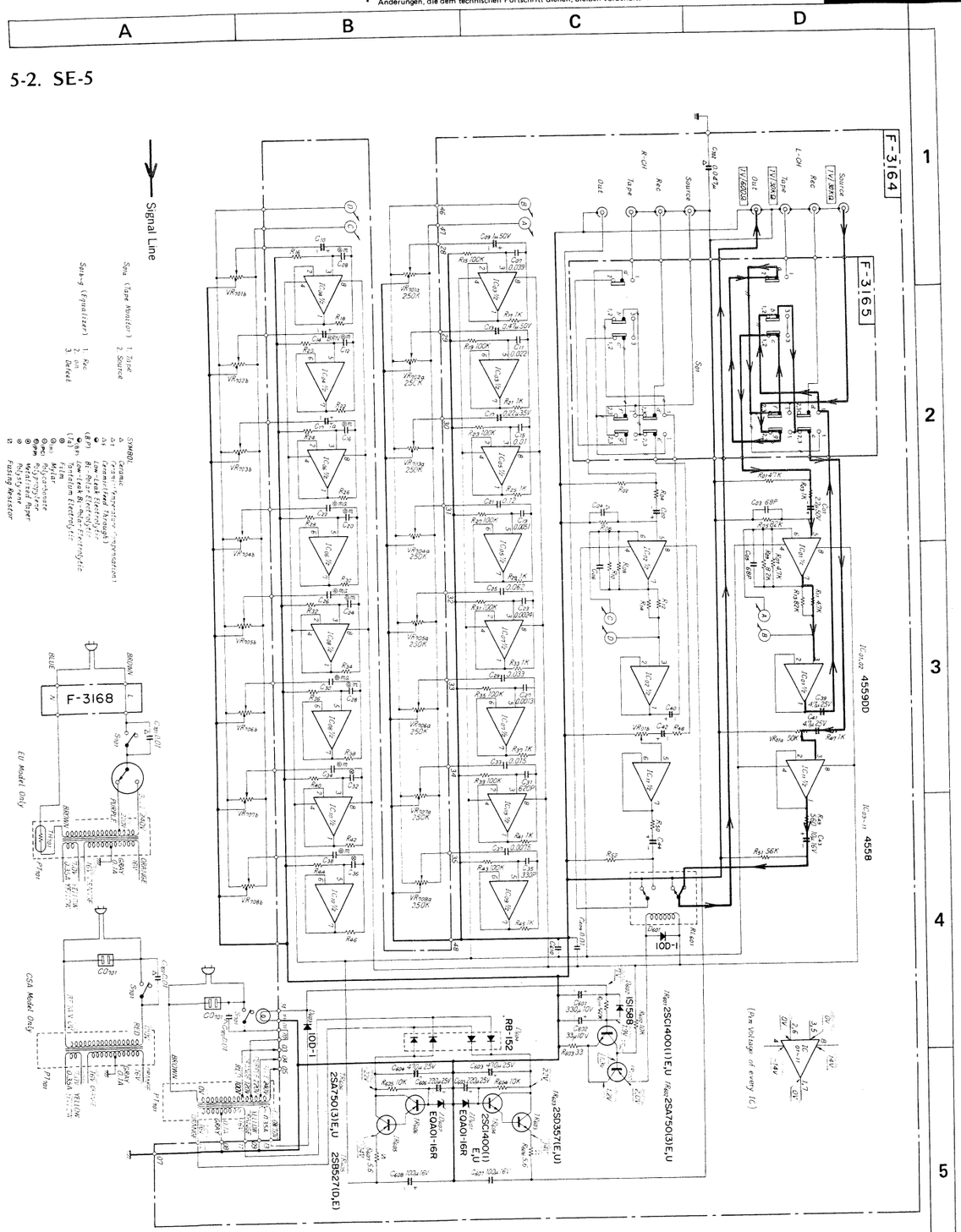
RB-1588

A	B	C	D	E	F	G	H

1 2 3 4 5 6

- Design and specifications subject to change without notice for improvement.
- La présentation et les spécifications sont susceptibles d'être modifiées sans préavis par suites d'améliorations éventuelles.
- Änderungen, die dem technischen Fortschritt dienen, bleiben vorbehalten.

5-2. SE-5



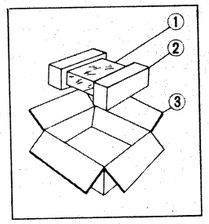
6. PACKING LIST

6-1. SE-5

Parts No.	Stock No.	Description
1	91167600	Vinyl Bag
2	90281010	Styrofoam Packing
3	90564300	Carton Case

6-2. SE-7

Parts No.	Stock No.	Description
1	91166910	Vinyl Bag
2	90284300	Styrofoam Packing
3	90564200	Carton Case (SE-7S)
	90564100	Carton Case (SE-7B)



7. ACCESSORY PARTS LIST

7-1. SE-5

Stock No.	Description
92049400	Operating Instructions
92385100	Schematic Diagram
38103300, 1	PJP Cord
07193400	PJP Cord
53967000	Rack Mounting Adaptor

7-2. SE-7

Stock No.	Description
92049200	Operating Instructions
92385000	Schematic Diagram
38103300, 1	PJP Cord
07193400	PJP Cord
53967100	Rack Mounting Adaptor (SE-7B)

●Since there are black & silver models in SE-7, please pay attention when ordering parts.
Parts marked (S) in parts list . . . . . for silver model only
Parts marked (B) in parts list . . . . . for black model only

Sansui

SANSUI ELECTRONICS CORPORATION: 1250 Valley Brook Ave. Lyndhurst, N.J. 07071 U.S.A.
333 West Alondra Blvd. Gardena, California 90247 U.S.A.
3036 Koapaka St. Honolulu, Hawaii 96819 U.S.A.
SANSUI AUDIO EUROPE N.V.: North Trade Bldg (9th floor) Noorderlaan 133-Bus 1,2030 Antwerp, Belgium
SNASUI AUDIO EUROPE S.A.: Arabella center, 6 Frankfurt AM Main, Lyoner Strasse 44-48, West Germany
SANSUI ELECTRIC COMPANY LTD.: 14-1, Izumi 2-chome, Suginamiku, Tokyo 168 Japan PHONE: (03) 323-1111/TELEX: 232-2076

(SM149) Printed in Japan(O93330M)